When Decentralization Fails: Governance and Inequity in California's Drinking Water System

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Abstract: In the United States, there are more than 151,000 drinking water systems which operate at a variety of decision-making scales and under various governance and ownership structures (US EPA, 2015). This extreme level of decentralization and fragmentation may allow for local control and flexibility, but it has not guaranteed safe drinking water for all (Hughes & Mullin, 2017; Pannu, 2012). In California alone, there are more than a million people each year receiving unsafe drinking-water. To further our understanding of how system governance contributes to these drinking water disparities, we compile and analyze a novel dataset including all 2,886 of California's active Community Water Systems and their health-based Safe Drinking Water Act violations (2012-2018) in order to answer two important questions: 1) how is California drinking water governance organized at the system level? 2) Do certain types of governance structures outperform or underperform compared to others? We find that while control variables such as population size remain most determinative of system performance, there are significant differences in SDWA compliance between distinct governance arrangements. These findings highlight the important role that governance, in its broader conception, plays in contributing to SDWA noncompliance and leads us to argue that determining the role of governance in creating disparities, therefore, is an important prerequisite to understanding how different arrangement might best address them.

Keywords: California, water governance, equity, justice, fragmentation

Introduction

In the United States, there are more than 151,000 community drinking water systems[1] supplying 282.5 million Americans (US EPA, 2015; Dieter et al. 2018). This extreme level of decentralization and fragmentation may allow for local control and flexibility, but it has not guaranteed safe drinking water for all (Hughes & Mullin, 2017; Pannu, 2012). In 2015, at least 21 million people across the United States were impacted by primary health standard violations of the Safe Drinking Water Act (SDWA) (Allaire, Wu, & Lall, 2018) and reporters estimate that in the last 10 years, up to 63 million Americans were exposed to unsafe water more than once (Philip et al. 2017). This is to say nothing of the 42.5 million Americans served by un- and under-regulated state small systems and households who self-supply from private domestic wells or surface water supplies (Dieter et al. 2018). The impacts of drinking unsafe water are not borne equally among populations. Rather, the burden of receiving drinking water with health-based SDWA violations falls most heavily on low-income communities, communities of color, indigenous communities and rural communities (e.g., Allaire et al. 2018; Switzer and Teodoro,

[1] A community water system is a Public Water System serves a consistent population year-round i.e. provides drinking water to at least 15 connections or at least 25 people for at least 60 days a year. Community water systems can be publicly or privately owned (US EPA, 2015).

2017; Pierce and Jimenez 2015; Balazs et al., 2012; Balazs et al., 2011; Hrudey, 2008; Stone, Sherman, & Hofeld, 2007).

Water governance is an intentionally broad framework for understanding both the process and outcomes of water provision that accounts for "the range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society (Rogers & Hall, 2003, p. 16). We know that good water governance is important for fostering effective, efficient and equitable outcomes and water system performance (Berg 2016). Nonetheless, very few scholars have connected water governance to these water quality outcomes (Pahl-Wostl et al. 2012; Newig and Fritsch 2009, Wujits et al. 2018), and much of what has been done is focused at the watershed or ecosystem scale (Franks & Cleaver, 2007) rather than at the water system level (MacFarlane and Harris 2018).

Drinking-water provision has historically been considered a primarily technical challenge, but drinking water governance is a growing field of study (Yates et al. 2017; Balazs & Ray, 2014; Beecher 2013; Bakker and Moriville 2013; Edwards, Henderson, Struck, & Kosatsky, 2012; Jepson 2012; Mullin, 2009; Maras, 2004). The study of governance at the drinking water system level is significantly constrained by the complexity, breadth and arguably ambiguity of the concept of 'governance' itself (Perreault, 2014; Berg 2016). And furthermore, it has been constrained by the frequency with which water is "rendered technical" (Li, 2007) by scholars, obscuring the inherently political nature of governance (Farhana 2013). The combination of both of these factors has led to a relative lack of governance related data at such a fine scale, especially when compared to technical and financial considerations for drinking-water systems. A consequence is that we have very limited understanding of how system-level governance shapes the intended outcome of delivering safe, clean, affordable drinking water (McFarlane & Harris, 2018). As a result, our knowledge of the role of governance in contributing to drinking water system regulatory compliance is surprisingly, and problematically, limited.

The result of insufficient attention paid to the role of governance has been that "compliance violations and drinking water advisories is often accepted as an inevitable outcome of geography and scale that can be mitigated but not resolved" (McFarlane & Harris, 2018, p. 385). Drinking water disparities, like many other forms of environmental injustice, have been depoliticized, ignoring the role of the state, and governance more broadly, not just through unequal protection but also its role in the social reproduction and reinforcement of inequality (C. L. Balazs & Ray, 2014; Pellow, 2016; Sze & London, 2008). In this paper we seek to heed calls to put the "state back in" (Evans, Rueschemeyer, & Skocpol, 1985), beginning the process of digging into the nuance and complexity of drinking water system governance to expand our understanding of the root causes of drinking water disparities among community water systems. Using California as a test case, we argue that determining the role of governance in creating disparities is an important prerequisite to understanding how governance-oriented solutions, like system consolidation, may play a role in addressing them.

Background and Rationale: Drinking water governance and water quality compliance

Contributions to our understanding of the relationship between water system characteristics to SDWA compliance in the U.S., each seem to take different slices of national drinking water system data and define the dependent variable of *violation count* differently (Kirchoff et al. 2019). Some limit research to CWS, while others include all PWS e.g. non-transient and non-community systems. Others limited their scope to specific ownership types (Switzer and Teodoro, 2017). Other efforts are limited to specific states like Virginia (Marcillo and Krometis 2019), Connecticut (Kirchoff et al. 2019), and Arizona (Rahman et al. 2010). This makes comparison of findings difficult, and in many cases their findings seem to conflict (relevant findings from these papers are summarized in Table 1).

Often these analyses limit the systems considered by size. While systems that serve 10,000+ people meet the needs of nearly 80% of the CWS-served US population, they make up less than 10% of the county's systems (EPA 2011). The majority of drinking water systems in America are small. While the total population served may be low, there is growing concern over the continued violations incurred by these systems and the public health consequences to their customers. This concerned is informed by a general consensus that small systems struggle and will continue to face challenges in complying with safe drinking water requirements (Scheberle 2004; McDonald et al. 2018; Oxenford and Barret 2016; Marcillo and Krometis 2019; Balazs et al. 2012). Understanding and addressing these unique challenges is hindered by the fact that many studies have failed to adequately include small systems in modeling efforts. For example, due to concerns with small system monitoring and reporting, Allaire et al.'s (2018) analysis of US drinking water quality violations excluded systems under 500 connections, thus excluding more than half of all community water systems (EPA, 2011) and the vast majority of private systems (Wallsten & Kosec, 2008). But since most small systems are found in lower-density, isolated rural parts of the county, Allaire et al.'s findings that rural areas had much higher incidences of violations than urban areas likely also speaks to systems < 500 connections. Other studies have also linked rurality to non-compliance (McDonald et al. 2018; Marcillo and Krometis 2019).

Likely due to the fact that data on system ownership is included in state and federal drinking water data, ownership is a rare governance characteristic that has been considered in recent studies of drinking water system SDWA violations. Readily available categories of ownership include *public*, which are owned and operated by a government or public agency city, county, state etc., *private*, can be both operated for profit as a water business, or as a non-profit, and *mixed* (public-private partnerships) among others (EPA 2009). Much of the literature reviewed includes ownership as an independent variable.

Despite this growing body of work, there is conflicting conclusions about the role of ownership on drinking water system performance. Generally, many of these studies are summarized to conclude that private systems outperform public ones, however this is a simplification of their findings. In their national scale analysis, Wallsten and Kosec (2008), found that among smaller systems, privately owned systems incurred significantly fewer maximum contaminant level violations compared to municipal systems but so too did federal and state systems compared to municipal systems. Konisky and Teodoro's (2016) assessment found that large private utilities were associated with lower SDWA violation counts compared to their large public utility counterparts.

At the state-level, findings are less convincing that private systems outperform publicly owned ones. Rahman et al.'s (2010) analysis of Arizona systems included all sizes but the analysis compared both public and privately owned systems to mixed-ownership CWSs, finding mixed ownership systems to significantly outperform both. Whereas in Connecticut, Kirchoff et al. (2019) found that publicly owned systems were associated with higher violation counts. One reason for this, as Kirchoff et al. (2019) explain, national scale analyses are unable to account for local- and state-specific drivers of non-compliance e.g. geography, politics, and the inter-play between the Primacy Agency and systems, among other drivers. Beecher (2013) argues emphatically that research has yet to empirically show that privatization is "*necessary* to overcome perceived deficiencies and improve utility performance" rather "what matters to performance […] is governance" (p. 152). It is unclear, therefore, how and if these findings are applicable to the totality of drinking water systems or to small systems in particular, including those in California.

Table 1. Relevant findings from similar studies

Conclusion	Set of Systems included	Reference
"compliance with SDWA regulations does not appear to depend much on system ownership"	All CWS in the US (1997 – 2003)	Wallsten and Kosec 2008
smaller water systems are no more likely than larger systems to violate health-related requirements	All CWS (2011)	Rubin 2013
"publicly owned PWS have slightly higher probability of violating MCL standards than privately owned systems"	971 PWS in Arizona (1993-2004)	Rahman et al. 2010
the smaller the system, the greater the percentage of violations	All systems (2013), focus on <10,000 people (small) PWS	Oxenford and Barret 2016
Public utility ownership is associated with higher SDWA violation counts, compared to private	Public *and* private utilities that serve 10,000+ people (2010-2013)	Konisky and Teodoro 2016
"in the poorest of communities that race and ethnicity seem to matter most in determining drinking water quality"	local-government owned utilities that serve 10,000+ people, (2010-2013)	Switzer and Teodoro, 2017
"evidence of racial inequities in the poorest of communities; members of racial and ethnic minorities face greater risk of unsafe water"	local-government owned utilities that serve 1,000+ people (2010-2013)	Switzer and Teodoro, 2018
"private ownership and purchased water source are associated with compliance"	All utilities that serve 500+ *connections* (1982-2015)	Allaire et al., 2018
Lower socio-economic status and minority groups are associated with an increased odds for initial and repeat drinking water violations	All CWS (2011-2015)	McDonald et al. 2018
Medium-sized CWSs had significantly more health-based violations Private systems had significantly more total violations than publicly owned systems.	All CWS in Virginia (1999-2016)	Marcillo and Krometis 2019.
State-ownership, groundwater dependence and rural location were associated with higher violation counts	PWS in Connecticut (2007-2016)	Kirchhoff et al. 2019.

A central feature of water governance literature is the attention paid to decentralization, subsidiarity, fragmentation and polycentrism (Bakker and Cook, 2011; Bakker and Morinville 2013; Pahl-Wostl et al., 2014). The fragmentation we observe is in part due to the fact that water is 'flow' resource—it is disinterested in abiding by socially constructed administrative boundaries. Additionally, environmental governance implementation in the past few decades has emphasized and often encouraged the decentralization of resource management and government functions as a means by which to facilitate flexibility, adaptability, and even accountability (Pahl-Wostl et al., 2014; Newig and Fritsch, 2009; Hooges and Marks, 2003). As Kirchhoff et al. (2019) remind us, the evolution of fragmented water governance is also specific to each geography, and rather than proposing broad strokes how small, rural water systems emerged throughout the US we discuss this more specific to the California context in the following section.

The role of governance in causing issues like violating the SDWA is not well researched or well understood. Beyond ownership, we are unaware of any investigations of US systems that consider the organization or decision-making structure of community water systems as a potential factor in mediating SDWA compliance. Thus, while governance is acknowledged as important to shaping water provision and quality outcomes (Wujits et al. 2016; Newig and Fritsch 2009), quantitative inquiries into SDWA compliance have remained constrained to the public/private binary and primarily to large/urban providers. It is precisely this gap that we seek take initial steps to explore with this paper.

Context: California's Drinking Water System

California is simultaneously an aberrant and highly unexceptional place to consider questions of water system level governance on quality of water supplied. California is unique in that it is the only state the United States where the human right to water has been affirmed in law. AB 685, passed in 2012 as the result of historic grassroots activism, declares "that it is the established policy of the state that every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes". However, the human right to water as law is a partial and limited political ideal (Perreault, 2014) and very clearly not yet achieved in California.

California's drinking water system involves a complex hierarchy of several different levels management and oversight. A key, but hardly unique feature, of the state's system is the sheer number of individual systems. California counts nearly 8,000 Public Water Systems (PWSs), roughly 3,000 of which are designated as Community Water Systems (CWSs) meaning that they serve a consistent, residential population year-round. All PWSs are responsible for meeting monitoring, reporting, and quality requirements articulated in federal and state regulations. The principle of subsidiarity defines this arrangement: state agencies do not take action or intervene in local system management until absolutely necessary (or it is legally required to do so) (Bakker and Morinville, 2013).

There are ten different state agencies implicated in drinking water management (SWRCB 2015). As of 2014, the Division of Drinking Water (DDW) which regulates system compliance with the SDWA falls under the State Water Resources Control Board. Previously, systems were regulated by the CA Department of Public Health, but it was moved with the hope of better aligning drinking water quality regulation with other related aspects of the state's water management. While most systems compliance with the SDWA are regulated by the SWRCB's DDW, for certain small systems a notable exception to this arrangement exists.

Prior to 1993, all CWSs with less than 200 connections were regulated by county health agencies. After an issues with the Federal EPA, now counties can apply for a regulatory role as Local Primacy Agencies (LPAs). There are currently 30 counties with LPA status who enforce the SDWA with <200 connections systems; in counties with small investor-owned water utilities, that responsibility is shared with the California Public Utilities Commission (CPUC). Regardless of their responsible regulator, however, all systems are monitored for compliance with the SDWA, and data is maintained in the state's Safe Drinking Water Information System (SDWIS) and reported to the federal Environmental Protection Agency (EPA).

Evolution of California's' Small System Landscape

The reality of drinking water access and quality in California's multi-level governance model is that more than a million people lack their human right to water; and this right differentiated along race, class and geographic axes, is well documented by public health scholar Dr. Carolina Balazs (C. L. Balazs et al., 2012; C. Balazs et al., 2011). Despite AB 685, the persistent drinking water crises continues to render certain Californians especially vulnerable to supply and quality disruptions during extreme events like droughts (Feinstein et al. 2017; Ekstrom et al. 2018) and fires (Saam 2019), and uneven development and local politics (London et al. 2018). Many Californians currently receiving unsafe water, from either their supplier or on un-regulated domestic well water, are within physical reach of long-term solutions like connecting to nearby systems (London et al. 2018).

The fragmentation of drinking water system governance is a function of the local land use decisions, politics and an unstated preference for subsidiarity by the state (and locals). The proliferation of small systems throughout the state is rooted in the history of California water development. Water in California is "egregiously localized" (Hundley 2001) and this localization is a key feature of drinking water disparities (Pannu 2012). London et al. (2018) trace this history in the San Joaquin Valley, reporting on racialized land use policies that excluded minorities from living places with city-supplied water and explicit policies of non-investment in unincorporated rural areas and their water supplies and implicit municipal under-bounding (Marsh et al. 2010; Aiken 1987). Essinger (2017) provides ethnographic accounts of a handful of rural African American communities in the Central Valley plagued by poor water quality and service for decades. Thus, water has first and foremost been a local management issue since colonization. The state operates under principles of subsidiarity to the determent of certain communities throughout the state, as hundreds of CWS consistently fail to deliver safe water.

California's efforts to address non-compliance with state and federal guidelines mirror the trends in the literature noted in the previous section. And much like the literature, California's advocates, policy makers and regulators have increasingly also turned their attention to governance as a solution, particularly the opportunity presented by small system consolidation. The number of systems and diversity of structures under which they are operated in the state poses a challenge for these conversations. Significant questions remain as to how to best ensure regulatory compliance and delivering on the promise of the human right to water. Whatever future solutions proposed to ensure that every Californian has safe drinking water will need to be developed and implement with considerations for representation and accountability (Nylen, Pannu, & Kiparsky, 2018).

Research Questions and Hypotheses

What is the relationship between the proliferation of small systems and the fragmentation of drinking-water provision with drinking-water governance in California? What can we learn from this extensive degree of decentralization with regard to the ultimate goal of achieving the state's human right to water law? With the aim of productively interrogating the intersection of decentralization and safe drinking water provision, this paper is guided by three specific research questions with three subsequent hypotheses, based on the literature reviewed and the authors' collective experiences and expertise working with community drinking water systems in California.

Q1: What type and degree of drinking water system governance diversity exists in California beyond private and public ownership?

> *H1: We expect to identify a large number of distinct organizational types among both privately and publicly owned community water systems in the state and that this diversity will be particularly pronounced among small systems compared to larger ones.*

Q2: Are privately owned systems less likely to incur health violations compared to their publicly-owned counterparts when considering all system sizes? Does this relationship change if we look only among only small systems?

> *H2: We expect that privately owned systems will be no more or less likely to incur health violations compared to publicly-owned systems when all community water systems are considered. Among just small systems (≤10,000 people), we expect that private systems will be significantly more likely to violate primary health standards.*

Q3: Does extending a governance analysis beyond considerations of public versus private ownership yield predictive and informative findings regarding the occurrence of health violations among Community Water Systems in California?

> *H3: We expect parsing Community Water System governance further, to consider diversity among public systems with respect to political jurisdiction and among private systems with respect to business type, will lend further insight into patters of primary health standard violations. Even more nuanced distinctions of water system organizational type, may demonstrate a pattern of underperformance among specific mechanisms of service provision.*

Methods

Data

In this study we employ cross-sectional data from the Safe Drinking Water Information System (SDWIS) of all active Community Water Systems in the state of California published by the SWRCB DDW in June 2018. We then updated this list of 2,911 systems to be current through the end of the 2018 calendar year by cross-referencing it with the dynamic online SDWIS database and SWRCB's Human Right to Water portal data.[2] Thus, our final dataset consists of 2,886 active community water systems which is our unit of analysis for this study.[3]

Models

To investigate the role of various governance characteristics in mediating SDWA compliance we estimate a series of statistical models. Our dependent variable is count data, which given the data's over dispersion suggests the use of a zero-inflated negative binomial model (ZINB) (Index of Dispersion (D) = 21.81). A ZINB is a mixture model which suppose two separate data-generating mechanisms, the first related to the occurrence of zeros and the later related to magnitude of the count for non-zero observations (Hilbe, 2011). Thus, in our case, these models therefore include both a binary logit component predicting compliance (violation count = 0) versus noncompliance (violation count > 0), between 2012 and 2018, and a negative binomial component predicting incidence of violations for non-compliant systems.

In specifying the model, we first consider the effect of dichotomous ownership variable on incurring health violations for all community water systems and then among only small systems (ZINBs 1 and 2 respectively). Next, with a one-way ANOVA difference of means test and a second ZINB, we extend our inquiry to consider the role of political jurisdiction and business type (ZINB 3). Finally, to test the hypothesis that even more micro-level differences in organizational structure are relevant to the incurrence of health violations, we specify a third ZINB to look at specific organizational types among publicly-owned systems. Together these analyses demonstrate the importance of attending to system-level variation for understanding the role of governance in mediating SDWA compliance.

Dependent Variable: Total health violations count

The SDWIS data includes a variety of characteristics about each system but no information about the performance of a given system including health violations. To obtain this information we add a count of health violations between 2012 and 2018 drawn from the state's

[2] This involved removing those systems that were no longer listed as active as of December 31, 2018. We also added nine new systems that had been included in the HRTW portal data and thus added to the SDWIS system since the June 2018 snapshot, five of which had been relisted as Community Water Systems whereas they had previously been listed as NC or NTNCs systems. Four additional systems had been created since June 2018.

[3] In addition to adjusting the dataset to extend through 2018 we removed 2 systems which were revealed to be public schools. We assume these two systems were mis-entered as CWS but are really non-transient non-community systems (NTNC) systems which are not included in our analysis. We also removed one Tribal system and 6 duplicative system entries from the list as well as ten systems with populations served listed under the 25 person cut-off for community water systems.

Human Right to Water database.[4] Notably, this database does not include total coliform violations (SWRCB 2018), which are the most common type of health violation (Allaire et al., 2018).[5] To address this shortcoming, we also added a count of Maximum Contaminant Level (MCL) (health) violations for the Total California Rule (TCR) and Revised Total Coliform Rule (RTCR) per system from an EPA SDWIS federal reports search for the same years (EPA 2019a). Summing the two variables, then, we create a total health violations count for the years 2012 through 2018 which is our dependent variable.

The choice to focus only on health violations is a deliberate one informed by our research objective to explicitly explore the relationship between community water system governance and access to safe drinking water (and by extension, implementation of the state's human right to water). Compiling two data sets for this objective was important when we consider that the HRTW, as of February 2019, lists 329 systems as "in Compliance" that had at least 1 TCR violation during our study period. A downside to focusing only on health violations, however, is that this count misses systems that are out of compliance with quality monitoring and therefore have unknown water quality but do incur monitoring and reporting violations.

Independent Variables

For the independent variables we coded three governance characteristics for each of the 2,886 systems: organizational type, political jurisdiction/business type and system ownership. Using the name of the systems as a starting place we inductively coded organization type with the goal of capturing as much institutional diversity as possible. For publicly owned systems, agency name usually directly corresponds to the parts of the water, government etc. code under which the body was formed making this process relatively straightforward with a few notable exceptions. County Water Districts (California water code section 30000) are legally allowed to drop the word "county" in their legal name. California Water Districts (Water code section 34000), in turn, are allowed to drop "California" from their name. Therefore, any given "water district" could either be a County Water District or a California Water District. To correctly assign such systems we therefore conducted secondary research on each "water district" consulting their websites and county records to determine the correct designation. Sanitary Districts (Cal. Health and Safety Code section 6400) are also allowed to adjust their names to best reflect the services they provide. Non-standardized names were carefully scrutinized to ensure accurate classification.

For privately owned systems, system names are highly unstandardized making organizational coding less straightforward. As a result, we relied on supporting documentation such as annual Consumer Confidence Reports, websites, tax filings and general Google searches

[4] Health violations were based on unique violation numbers excluding monitoring and reporting violations. Health-based violations include: violations of maximum contaminant levels (MCLs) (average, single sample, and LRAA), maximum residual disinfectant levels, and treatment technique rules e.g. failure to filter, or failure to provide LT2 treatment (EPA 2019).

[5] The Human Right to Water portal also does not include public water systems in this database that have no current monitoring data reported, such that their compliance status is unknown; systems that exceeded a standard, but no enforcement actions was taken (SWRCB 2018). These systems were marked as NA in our database and removed from the models.

using each systems name and location (state and county or city) to identify specific organization types such as Mutual Water Companies or Property Associations. Finally, we cross-referenced these systems with the list of water systems that are investor-owned utilities (IOUs) maintained by the California Public Utilities Commission (CPUC), the state entity charged with overseeing this subset of systems. Even still, a significant portion of privately-owned systems remain in a generalized "other private" organizational type category which represents for-profit, not investor owned systems including, for example, individually or family owned businesses.

This necessarily constrains the descriptive power of our analyses amongst privately owned systems, nonetheless we believe the disaggregation of mutual-benefit/non-profit water companies and share-holder driven IOUs from the remainder represents what we believe to be a significant and interesting distinction in business orientation and decision-making structure and a marked improvement to a generalized "private systems" reference category as had been our original plan. We leave mobile home parks as their own category because they are subject to unique regulations and limited oversight by the CPUC and existing literature notes a pattern of drinking water challenges in these communities (Pierce & Gonzalez, 2017; Pierce and Jimenez 2015). Notably, while mobile home parks can be collectively or individually owned, it is not possible to disaggregate them as such with existing data.

After careful review and refinement, this inductive coding process ultimately resulted in 29 distinct organization types defined by a system's legal structure/derived authority, who operates it and/or who it serves. While this level of detail is important for facilitating our objective of investigating the nuance of drinking water governance in California, it also poses significant challenges for statistical analyses. Further, while arguably distinct in their specific legal organization, many of the 24 categories, especially amongst the publicly owned systems, have more in common than they do differences. For example, County Service Areas, Maintenance Districts and County Water Works Districts are all subsidiary districts of county government, run by county staff under the direction of the Board of Supervisors for a specific geographic area in their jurisdiction. To address both the statistical constraints and recognize these significant commonalities among types, we grouped the 24 publicly owned organizational types into five political jurisdictions. We also group the five privately owned organization types into four business types, combining homeowner/property associations with mutual water companies since both can be considered non-profit and user owned utilities (see Table 5).

Finally, the SDWIS data included a field for ownership with five categories (Private, Local, State, Federal, Mixed). As we coded organization type we aggregated this field into a dichotomous public/private ownership variable with private systems remaining "private" and local, state and federal systems designated "public". Mixed systems were assigned based on their majority shareholder. In this process, we identified 128 likely mistakes in the California SDWIS data snapshot we started from (for example a Community Services District formed under Government Code §610000 is by definition not private) we incorporated these corrections in our coding.

Controls

Drinking water quality is of course highly dependent on source water. We control for water source in the models by including a systems primary water source, either groundwater or surface water, as a dichotomous variable. We also include a dummy-variable for systems whose primary water source is purchased water from a wholesaler. System size is also a well-known determinant of performance (Allaire et al., 2018; Wallsten & Kosec, 2008). To account for this affect we include the logged population served by the system, as well as an interaction term between system size and ownership type (similar to Marcillo and Krometis 2019). Table 2 includes a summary of all model terms and their respective descriptive statistics.

Table 2. Model terms and descriptive statistics

Term	Type	Descriptive Statistics
Total violations, health-based (Dependent variable)	Count	$\mu = 2.28$, $\sigma = 7.04$
Ownership	Dichotomous	59.7% private (1), 40.3% public (0)
Organization type	Factor with 29 levels	See Table 3
Political Jurisdiction (publicly owned systems only)	Factor with 5 levels	See Table 3
Business type (privately owned systems only)	Factor with 4 levels	See Table 3
Logged population served	Integer	$\mu = 6.42$, $\sigma = 2.47$
Primary water source	Factor with two levels	73.04% groundwater, 26.96% surface water
Purchased water, as Primary water source	Factor with two levels	14.41% primarily rely on purchased, 85.6% do not primarily rely on purchased

Results and Discussion

Summary Statistics: California's drinking water governance landscape

Prior to considering the modeling results, this novel data set warrants its own exploration and discussion. Of the 2,886 active CWSs included in our analysis, 40.3% (n=1,163) are publicly owned while another 59.7% (n=1,723) are privately owned. Overall, 2,411 or 83.5%, of all community water systems meet the SWRCB's definition of small water systems based on the population criteria (population ≤ 10,000). Sixty-eight percent (n=1,638) of these small systems are private whereas just 17.9% of large systems are privately owned.

Considering only systems under 3,300 people (US EPA's definition of small), 72.6% are private and for systems serving under 500 people (very small), 81% are private (Figure 1). Thus, California, not surprisingly, closely aligns with national trends in water system ownership (Edwards et al., 2012; Konisky & Teodoro, 2016; McFarlane & Harris, 2018; Wallsten & Kosec, 2008). The inverse relationship between ownership and size points to a possible relationship between ownership and performance when all systems or just small systems are considered compared to existing analyses.

Table 3 shows the breakdown of California's community water systems by political jurisdiction/business structure and organizational type. For publicly owned system, by far most system fall under the jurisdiction of independent special districts (n=564 or 48.5%), followed by cities (n=316 or 27.2%). The least common political jurisdiction is regional Joint Powers Authorities representing just 12, or 1%, of the publicly systems. Looking to the even finer level of detail of organization type, most public systems are administered by cities (n=314) followed by Community Services Districts (n=185) and County Water Districts (n=165). The least common organizational types are Resource Conservation Districts, with only a single such district operating as an active community water system in the state. Of the state's 1,723 privately owned systems, most are user owned non-profit, mutual benefit organizations (n=651 or 37.8%); a category which includes 70 property or homeowners' associations and 581 mutual water companies. Investor Owned Utilities represent the minority of privately owned systems (n=220 or 12.8%) (Table 3).

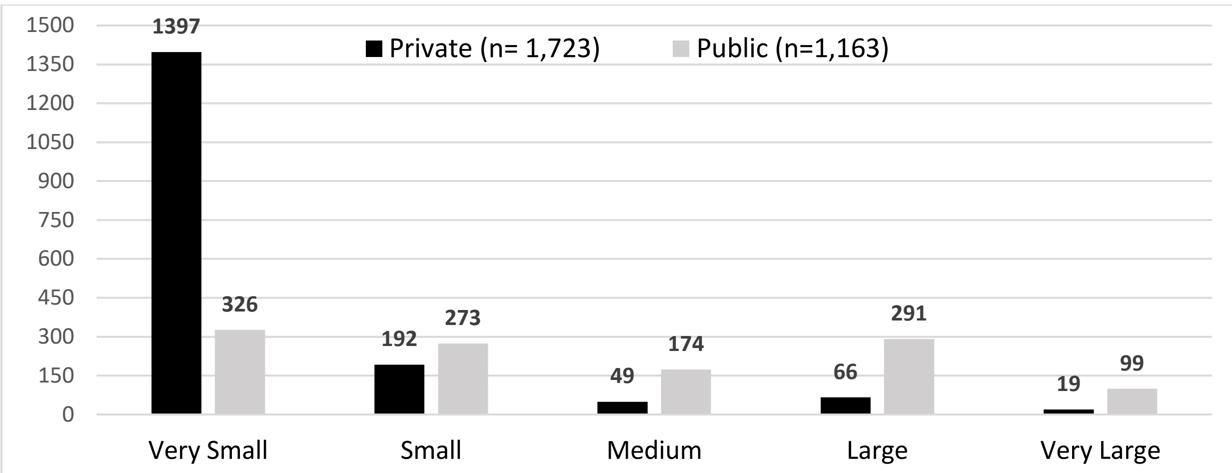

Figure 1. Count of Community Water System ownership by size. EPA's size classifications: Very Small (< 500 people), Small (501-3,300), Medium (3,301 – 10,000), Large (10,001 – 100,000) and Very Large (>100,000)

Twenty-eight distinct organizational types are found among the 2,411 small water systems compared to twenty-two types for large systems. Using the median population served for each organizational type to classify types as either predominantly small versus predominantly large, we find seven organizational types that are predominantly large systems: (Water Conservation Districts, Joint Powers Authorities, Resource Conservation Districts, Municipal Water Districts, City, Special Act District (City council serves as board) and Special Act Districts (independent governing board). The remaining twenty-one types are predominantly small system types. Therefore, we confirm Hypothesis One, that there is demonstrable diversity among private and publicly owned community water systems and that this diversity is greater for small systems.

Table 3. Ownership, political jurisdiction/business type and organization type of California's Community Water Systems (n=2,886)
[table is pending completion]

Ownership† (n)	**Political jurisdiction/ business type (n)**	**Organization Type (n)**	**Description**	**Legal definition or examples**	**Median population served**
Public (1,163)	Federal and State (88)	Federal (38)	Systems owned and operated by federal agencies	Department of defense, Federal prisons, National Park and National Forest Facilities	1,324
		State (50)	Systems owned and operated by state agencies/institutions	State prisons and other correctional facilities, Public Universities and research facilities, state parks	2,890
	Regional, cross-jurisdictional (12)	Joint Powers Authority / Agency / Agreement (12)	Multi-party collaborations among two or more public agencies	Cal. Government Code § 6500	109,254
	County (183)	County departments (excluding sheriff) (11)	??	County public works, environmental health, housing authorities	432
		Special Act District (Board of Supervisors serves as board of directors††) (8)	Unique codified districts created by the legislature in which a county Board of Supervisors is designated as the governing body	Various chaptered acts	6,171
		County Sheriff (12)	Systems operated by county sheriff departments	Jails, probation and sheriff facilities	350
		County Service Area (77)	Subsidiary districts of the county whereby the board of supervisors provisions services in unincorporated communities	Cal. Government Code § 25210	395

		County Water Works District (27)	Subsidiary districts of the county whereby the board of supervisors provisions services in unincorporated communities	Cal. Water Code § 55000	1,527
		Resort Improvement District (Board of Supervisors serves as board†††) (2)		Cal. Public Resources Code § 13000	730
		Maintenance District (46)			154
	Independent Special Districts (564)	Irrigation District (51)		Cal. Water Code § 20500	2,340
		Resort Improvement District (independently elected board†††) (2)		Cal. Public Resources Code § 13000	900
		Community Services District (185)		Cal. Government Code § 610000	913
		Municipal Utility District (3)		Cal. Public Utilities Code § 11501	255
		Municipal Water District (3)		Cal. Water Code § 71000	37,150
		Public Utility District (53)		Cal. Public Utilities Code §15501	2,620
		Sanitary District (6)		Cal. Health and Safety Code §6400	1,956
		Special Act District (independently elected board††) (33)		Various chaptered acts	12,480
		Water Conservation District (3)		Cal. Water Code § 74000	226,044
		California Water District (32)		Cal. Water Code § 34000	614
		Resource Conservation District (1)		Cal. Public Resources Code § 9151	40,461
		County Water District (165)		Cal. Water Code § 30000	3,154
	City (316)	City (314)		??	22,868

		Special Act District (City council serves as board††) (2)		Various chaptered acts	17,987
Private (1,723)	Investor Owned Utilities (220)	Investor-Owned Utility (220)	Shareholder owned without restriction that shareholders also be residents/customers	??	1,695
	User owned utilities (651)	Mutual Water Company (581)	Shareholder owned where shareholders are residents/customers, mutual benefit and not for profit.	??	130
		Property or Home Owners Association (70)	Member owned organizations for service provision in housing developments, mutual benefit and not for profit	Cal. Civil Code section § 4000	78
	Mobile Home Parks (371)	Mobile Home Park or Campground (371)		??	110
	Other Private (481)	Other Private (481)	All other privately-owned systems		80

† The authors made 128 updates to the "ownership" type category based on additional research. For example, there were at 76 'private' systems in the SDIWS data that are actually public districts
†† Special Act Districts are districts created by unique legislation passed by the state legislature. Thus, rather than being a distinct type of special district, special act districts represent a distinct pathway to formation. Each has uniquely determined powers and structure. For our coding we divided them into three types based on their individual structure, Special Act Districts where the Board of Supervisors serves as the board, Special Act Districts where a city council serves as the board and Special Act Districts with unique independently elected boards most akin to other forms of special districts.
††† Public Resources Code allows for two governing board alternatives, either the board of supervisors serves as the board of directors or an independent board of directs can be elected popularly.

Overall our dataset includes 6,566 violations over the seven-year period with a mean of 2.26 violations per system. However, 2,035 systems, or 70.5%, have zero violations, indicating full and consistent compliance with primary health standards between 2012 and 2018. For the 851 systems with violations, the range is one to 94 with a mean of 7.72 and a median of 2. Comparing ownership against violations, we see that 32.2% of privately-owned systems and 25.4% of publicly-owned systems incurred at least one health-based violation in the last 6 years. Table 4 displays information about violations by ownership and political jurisdiction/business type as well as overall for the dataset the models use.

Table 4. Count of health-based violations for 2012-2018 by system ownership and organization types

	Number of systems	**Number of systems w/ violations**	**Sum of health violations**	**Mean violations**	**SD**
All CWSs	2886	851	6566	2.26	7.04
By ownership type					
Public	1163	295	2244	1.93	6.40
Private	1723	556	4322	2.51	7.44
By organization type					
City	316	80	452	1.43	5.25
County	183	55	564	3.08	9.04
Joint Powers Authority (JPA)	12	0	0	0	0
Independent Special Districts	564	132	1020	1.81	5.92
State and Federal	88	28	208	2.36	6.79
Private	481	177	1618	3.36	8.94
Private – Mutual Benefit	651	218	1526	2.34	7.09
Private - IOU	220	39	327	1.49	7.09
Mobile Home Parks	371	122	851	2.29	5.86

Modeling the relationship between health violations and private/public ownership

We begin our predictive modeling efforts by exploring the effect of system ownership on water quality violations. As previously noted, Allaire et al. (2018) found that private systems outperform public ones when it comes to health violations. Similar findings have also been found in other studies (Konisky & Teodoro, 2016; Rahaman & Varis, 2005; Wallsten & Kosec, 2008). To determine how this finding might apply for all system sizes and for small systems in particular in the California context we develop a Zero-Inflated Negative Binomial Regression (ZINB) for total health violations consisting of our dichotomous ownership variable and the three controls with an interaction term in for population served (control variable of natural log of population served) and ownership. Appendix A presents the exponentiated coefficients from ZINB, Odds Ratios (ORs) and Incident Rate Ratios (IRRs) for the binomial logit and count portions respectively as well as the full model results.

While, given the dispersion, we anticipated that the ZINB would be the most appropriate model to fit our data, we still compared the ZINB to a standard Poisson model, a Zero-inflated Poisson (ZIP) model and a standard Negative Binomial Regression (NBR2) model to ensure the best fit. Using Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) as well as Vuong tests (ZIP versus Poisson and ZINB versus NBR) and a boundary likelihood ratio test (ZINB versus ZIP). All evidence points to using the ZINB which has an AIC of 8058.22 compared to the next best model's (NBR) AIC of 8070. The ZINB has a dispersion statistic of 1.2 which approximates one and using a chi-squared test to compare the model to a null model, the ZINB is shown to be highly significant ($p<0.0001$).

The odds of not incurring a single health violation between 2012 and 2018 are significantly higher for publicly owned systems compared to privately owned systems when controlling for the differential effect of population served on the two categories. That is to say the model shows that public systems are more likely to be in compliance excluding all considerations of size, but that the significantly positive effect of increasing size is much stronger for private systems than public systems. Thus non-compliance decreases significantly more rapidly for private systems compared to public systems as population increases. As a result, while public systems are more likely to be in compliance for the smallest systems, these relative positions swap as the population served increases. When it comes to non-compliant systems, however, public ownership significantly increases the incident rate of health violations causing a nearly 230% increase in incidence of health violations compared to private systems (Appendix A).

Sub-setting the model to only consider small systems, or those serving populations of less than or equal to 10,000, the effect of public ownership remains positive but becomes insignificant both in predicting compliance (zeros) as well as violation counts. The interaction effect between size and ownership remains significant for the binomial portion of the model, where increasing population for private systems continues to increase the likelihood of compliance much more so than the corresponding increase for public systems. This effect for the magnitude of violations in the count portion of the model, however, is not significant. Exponentiated coefficients for this ZINB model are displayed in Appendix B along with the full model results.

Together these finding provide a relatively more complicated understanding of the relationship between ownership and performance. Overall, public systems are both more likely to be in-compliance than private systems and more likely to have an increased incidence of violations among non-compliant systems than private systems. This relationship is mediated by size. Increasing the size of a system has a larger magnitude effect on being in-compliance (zero health violations) for private systems than public systems.

Among just small systems, public systems are neither significantly more likely to be in-compliance nor do they have a significantly increased incidence rate of health violations, making the ownership distinction statistically insignificant. In determining compliance, however, the combination of private ownership and increasing size does significantly increase the odds of zero-violations in the period compared to public systems. Therefore, we accept a modified version of Hypothesis Two, that overall, private systems in California are not significantly more or less likely to violate health standards including among only small systems but that the combination of increasing system size and private ownership does have a significant positive effect. In both models control coefficients align with expectations and previous findings.

Beyond Ownership: Political jurisdiction and business type

Could a more detailed look at additional system governance characteristics provide more predictive power? Figure 2 provides a box plot for the count of health violations by organization type. Conducting a one-way ANOVA difference of means test of the ten organizational types yields a significant p-value of p=0.002 indicating that the types are significantly different (ANOVA results for public versus private systems yields a p-value of 0.03). Updating our ZINB to replace the dichotomous ownership variable to include political jurisdiction and business types excluding JPAs due to the limited number of observations in that category (n=12), we test Hypothesis Three that further disaggregating systems by their governance characteristics will yield more predictive results.

This model, hereafter referred to as ZINB2, is fully reported in Appendix C. We use cities as the reference category because the type's mean violation count is the lowest of all types. ZINB2 reduces the AIC by more than 11 points compared to ZINB, indicating an improvement. The dispersion statistic is 1.07. The Z-statistic from Vuong Test shows a slight preference for ZINB2 (p<0.03). Thus, while we can confirm Hypothesis Three, the findings are not as different or informative as expected. Two political jurisdictions, county and independent special districts, and one business type, IOUs, are significantly more likely to be in-compliance (zeros) for the seven-year period compared to the reference category of city systems. Interestingly, despite city systems overall low mean violation count, the only type less likely to be a zero than city systems are state and federal systems, although this finding is highly insignificant. Considering the count portion of the model, the incidence of violations between types is not significantly different.

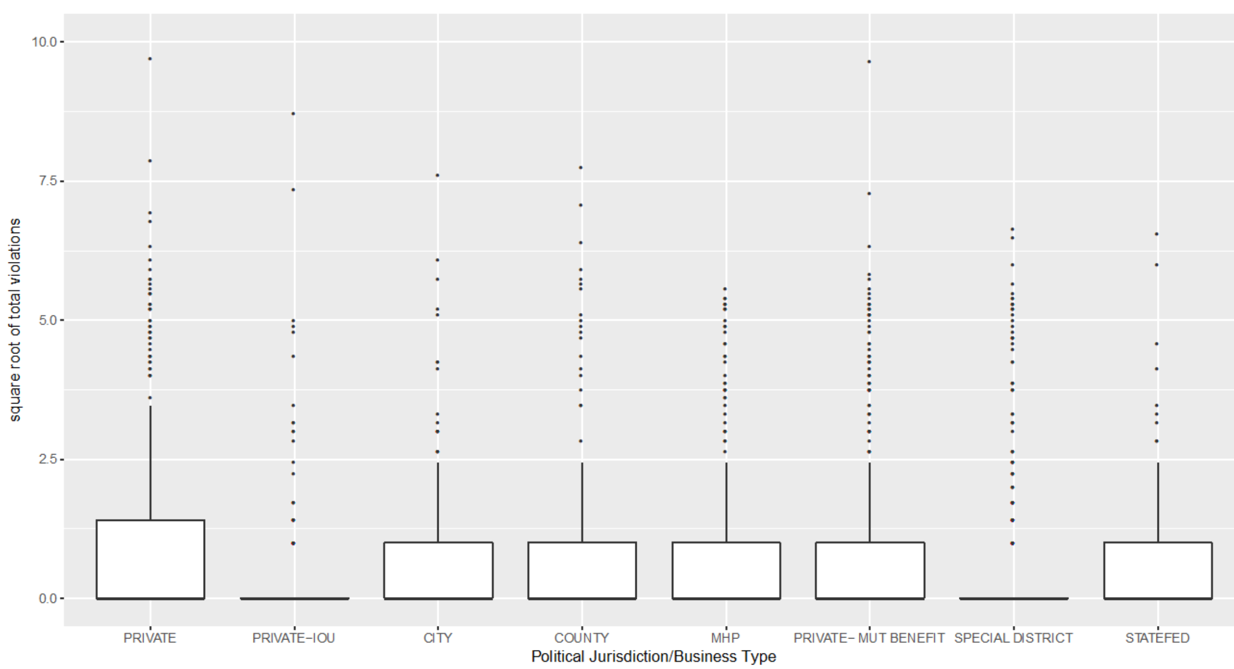

Figure 2. Square root of total violations by political jurisdiction/business type.

Organizational Types

The distribution of organizational types necessarily contains inferential analysis due to the limited number of observations per category. Nonetheless we specify a final model, referred to here as the Organizational Types model, to further probe hypothesis three and explore the effect of still further disaggregation in governance type. Subsetting our dataset to only include observations for the 12 publicly-owned, organizational types with at least 30 observations we model violation count for a final time. The results of the Organizational Types model are fully reported in Appendix F. Exponentiated coefficients are found in Table 7.

While the binomial portion of the model yields relatively little by the way of findings, with only the control variables demonstrating a significant effect, but the count portion is a very different story. Compared to the reference category of Municipal Water Districts (the highest performing organizational type of the 12 by mean violations), 7 organizational types have significantly increased incidence rates of health violations. These types include Cities, County Service Areas, Community Services Districts, Federal systems, Irrigation Districts, Public Utility Districts and state systems. A one-way ANOVA different of means test between these twelve categories yields highly significant p-value (p=0.003).

Conclusion and Future Directions

Our findings complicate standard discussions about water system ownership, and particularly privatization as an avenue by which to arguably improve performance. As evidenced in the literature reviewed, public and private systems have each been shown to outperform the other, contingent on subset of water systems, years of violation data, and place-based analyses. We emphasize the important and mediating role of size among *both* publicly and privately owned systems on the occurrence of primary health violations. Our model shows that public systems are more likely to be in compliance *excluding* all considerations of size; but as system size increases, we find private systems more likely to be in compliance than public systems.

Overall, we find that while controls such as population size remain most determinative of system performance in terms of SDWA compliance, there are significant differences between governance characteristics to go beyond ownership to the organizational type—namely political jurisdiction and business type. For the smallest systems, public ownership is associated a higher likelihood of compliance, but not as population grows. We also found a demonstrable diversity of governance types California's for small systems- 28 different organizational types, compared to 22 types for large systems-- further illustrating the challenges that fragmentation and decentralization pose.

At the more macro-level of political jurisdiction and business type, county systems and those operated by independent special districts and IOUs are all significantly more likely to be in compliance compared to cities; and overall, the ZINB model was improved by the switch from the dichotomous public/private ownership variable to one with nine-categories of organizational type. Notably, however, no significant difference between types was observed for the incidence of violations among systems. On a more micro-level, 7 of 11 organizational types have significantly increased incidence rates of health violations compared to the reference category (city), demonstrating organizational type to be a significant mediator or number of violations among non-compliant publicly-owned systems.

While these findings point to important differences among different forms of drinking-water service provision present in California, this study does not offer insight into how or why these differences matter. Future work should address specific potential causal mechanisms for compliance/non-compliance related to the organizational type diversity identified here. For example, some of the organizational types identified here serve customers that neither pay for the service nor have any direct ability to influence management, such as federal and state prisons, whereas other types serve rate-payers at distinct geographies, from small unincorporated hamlets to large cities.

Our findings also lend support to the assertion that the human right to water is ultimately a political question. For certain independent special districts and cities, the political boundaries of the decision-making entity and the Community Water System (CWS) service boundaries are mostly aligned, in others, most notably systems operated by County Board of Supervisors, a particular CWS may represent only a small fraction of the residential population in one district of a much broader electoral boundary. Independent Special Districts serving specific unincorporated communities, in turn, operate very similarly to mutual water companies and property associations, with volunteer, community-elected water boards, the key difference, however, being the imposition of homeownership requirements for voting in the privately-owned systems. Further, as previously mentioned, California's fragmented regulatory systems means that some systems are regulated directly by the State Water Resources Control Board while others report to a specific department/division of their County. Understanding the effects of these and other factors on Safe Drinking Water Act compliance with primary health standards is a critical next for tackling pervasive drinking water disparities.

Future work should also address the socio-spatial distribution of underperforming governance arrangements in the state. Only 30% of the water systems were non-compliant in the last 7 years—who are they serving? As others have shown to be the case, we would expect that low-income communities of color are those most impacted. To the extent that particular governance arrangements facilitate or impede access to safe, clean and affordable drinking water, the ways be which these systems have been organized spatially is of critical importance, including legacies of uneven development and exclusionary land-use practice,. Such investigations are crucial for informing conversations about system consolidations and for envisioning additional governance remedies well attuned to the distinct governance challenges of decentralized drinking-water provision.

Thus, this research highlights the important role that water system governance, in its broader conception, plays in contributing to noncompliance. Drinking water is inherently a political question and should always be considered as one. For public and privately-owned systems alike, questions of who makes decisions, at what scale and for whom are key to understanding performance outcomes. These questions are far more complex than the scholarly debate thus far. With this paper we hope to open the door to more nuanced and detailed analysis of system governance in California and beyond.

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Appendix A: ZINB Model, all systems

Table 5. Exponentiated ZINB coefficients - Odds ratios (zero) and Incident Rate Ratios (count) with 95% ci

	Zero			Count		
Model Term	**Estimate**	**2.50%**	**97.50%**	**Estimate**	**2.50%**	**97.50%**
Ownership - Public	48,667.69	66.32	35,715,486.00	3.29	1.17	9.19
Population (LN)	2.06	1.19	3.55	0.83	0.74	0.94
Primary water source – Surface water	0.12	0.02	0.88	1.15	0.85	1.54
Purchased water - Yes	15.73	2.56	96.5	0.44	0.29	0.66
Ownership - Public * Population (LN)	0.24	0.11	0.54	0.91	0.78	1.06

Table 6. ZINB model coefficients and standard errors

	Dependent Variable – Total Violations	
Model Term	**Zero**	**Count**
Constant	-8.057*** (2.959)	1.878*** (0.306)
Ownership - Public	10.793*** (3.367)	1.190** (0.525)
Population (LN)	0.722*** (0.278)	-0.184*** (0.061)
Primary water source – Surface water	-2.133** (1.023)	0.138 (0.151)
Purchased water - Yes	2.755*** (0.926)	-0.827*** (0.212)
Ownership - Public * Population (LN)	-1.413*** (0.402)	-0.098 (0.079)
Observations		2,886
Log Likelihood		-4,016.109
Note: *p<0.1; **p<0.05; ***p<0.01		

Appendix B: ZINB model subsetted for only small systems

Table 7. Exponentiated ZINB coefficients for only small systems - Odds ratios (zero) and Incident Rate Ratios (count) with 95% ci

	Zero			Count		
Model Term	**Estimate**	**2.50%**	**97.50%**	**Estimate**	**2.50%**	**97.50%**
Ownership - Public	2.08	0.56	7.68	$12.4 * 10^{14}$	0.06	$2.77 * 10^{27}$
Population (LN)	0.91	0.8	1.03	30.64	0.58	1,622.31
Primary water source – Surface water	1.29	0.93	1.78	0.07	0	0.92
Purchased water - Yes	0.49	0.29	0.84	15.63	1.83	133.55
Ownership - Public * Population (LN)	0.93	0.76	1.14	0.02	0	0.97

Table 8. ZINB model for only small systems - coefficients and standard errors

	Dependent Variable – Total Violations	
	Zero	**Count**
Constant	1.442^{***} (0.319)	1.442^{***} (0.319)
Ownership - Public	0.732 (0.666)	0.732 (0.666)
Population (LN)	-0.097 (0.064)	-0.097 (0.064)
Primary water source – Surface water	0.251 (0.167)	0.251 (0.167)
Purchased water - Yes	-0.708^{***} (0.270)	-0.708^{***} (0.270)
Ownership - Public * Population (LN)	-0.072 (0.105)	-0.072 (0.105)
Observations		2,411
Log Likelihood		-3,596.80
Note: *p<0.1; **p<0.05; ***p<0.01		

Appendix C: ZINB2 Model

Table 9. Exponentiated ZINB2 coefficients - Odds ratios (zero) and Incident Rate Ratios (count) with 95% ci

	Zero			Count		
Model Term	**Estimate**	**2.50%**	**97.50%**	**Estimate**	**2.50%**	**97.50%**
County	172.11	2.27	13,049.21	1.54	0.72	3.28
Mobile Home Park	11.83	0	55,848,712.00	0.77	0.36	1.65
Private - Other	8.61	0.03	2,786.13	1.11	0.55	2.24
Private - Mutual Benefit	8.36	0.02	2,827.99	0.85	0.43	1.65
Private - IOU	83.72	2.08	3,367.76	0.98	0.44	2.18
Independent Special District	42.62	1.26	1,436.85	1.16	0.66	2.03
State and Federal	0	0	1	1.22	0.6	2.46
Population (LN)	1.84	1.07	3.15	0.89	0.79	0.99
Primary water source – Surface water	0.48	0.09	2.51	1.22	0.87	1.71
Purchased water - Yes	8.79	1.37	56.2	0.49	0.3	0.81

Table 10. ZINB1 model - coefficients and standard errors

	Dependent Variable – Total Violations	
Model Term	**Zero**	**Count**
Constant	-10.121*** (3.490)	1.645*** (0.566)
County	5.148** (2.208)	0.429 (0.387)
Mobile Home Parks	2.470 (7.841)	-0.258 (0.388)
Private - Other	2.152 (2.949)	0.107 (0.357)
Private - Mutual benefit	2.123 (2.972)	-0.167 (0.342)
Private - IOU	4.428** (1.885)	-0.023 (0.408)
Independent Special District	3.752** (1.795)	0.146 (0.288)
State and Federal	-8.481 (196.064)	0.195 (0.359)
Population (LN)	0.607** (0.276)	-0.120** (0.057)
Primary water source – Surface water	-0.734 (0.843)	0.199 (0.171)
Purchased water - Yes	2.173** (0.947)	-0.715*** (0.255)
Observations	2,874	
Log Likelihood	-3,999.55	
Note: *p<0.1; **p<0.05; ***p<0.01		

Appendix D: Organization type model

Table 11. Exponentiated Organizational Type model coefficients - Odds ratios (zero) and Incident Rate Ratios (count) with 95% ci

	Zero			Count		
Model Term	**Estimate**	**2.50%**	**97.50%**	**Estimate**	**2.50%**	**97.50%**
City	5.2	0.02	1,352.67	14.33	2.57	79.86
County Water District	1.43	0	449.83	4.42	0.75	25.97
County Service Area	0.34	0	98.63	8.62	1.24	59.81
Community Services District	0.05	0	18.88	7.95	1.34	47.32
Federal	2.65	0.01	691.07	21.7	2.85	165.05
Irrigation District	27.12	0.06	12,123.26	8	1.05	60.88
Maintenance District	0.02	0	10.45	4.15	0.56	30.82
Public Utilities District	0.88	0	307.97	12.76	1.93	84.55
Special Act District	613.42	0.87	433,794.40	3.19	0.26	38.65
State	1.11	0	351.62	11.96	1.73	82.75
California Water District	0.45	0	178.91	6.46	0.81	51.26
Population (LN)	0.39	0.23	0.66	0.68	0.59	0.79
Primary water source – Surface water	0.01	0	0.16	0.8	0.48	1.33
Purchased water - Yes	21.63	2.28	204.77	0.73	0.42	1.28

Table 12. Organizational type model - coefficients and standard errors

	Dependent Variable – Total Violations	
Model Term	**Zero**	**Count**
Constant	5.715^{*} (3.199)	1.841 (1.144)
City	1.648 (2.838)	2.662^{***} (0.876)
County Water District	0.361 (2.933)	1.487^{*} (0.903)
County Service Area	-1.091 (2.899)	2.154^{**} (0.988)
Community Services District	-3.035 (3.048)	2.074^{**} (0.910)
Federal	0.974 (2.839)	3.077^{***} (1.035)
Irrigation District	3.300 (3.114)	2.079^{**} (1.036)
Maintenance District	-3.926 (3.201)	1.423 (1.023)
Public Utilities District	-0.133 (2.991)	2.546^{***} (0.965)
Special Act District	6.419^{*} (3.348)	1.161 (1.272)
State	0.108 (2.936)	2.482^{**} (0.987)
California Water District	-0.793 (3.051)	1.866^{*} (1.057)
Population (LN)	-0.934^{***} (0.263)	-0.381^{***} (0.073)
Primary water source – Surface water	-4.758^{***} (1.506)	-0.227 (0.261)
Purchased water - Yes	3.074^{***} (1.147)	-0.314 (0.285)
Observations		1,074
Log Likelihood		-1,308.11
Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$		